CONTRIBUTIONS FROM THE LOS ANGELES MUSEUM - CHANNEL ISLANDS BIOLOGICAL SURVEY

18. A STREPSIPTEROUS PARASITE OF A LEAF HOPPER, WITH DESCRIPTIONS OF RELATED SPECIES FROM THE SAME HOST GENUS

By W. Dwight Pierce

On West Anacapa Island, Sta. Barbara Co., California, on August 21, 1940, George P. Kanakoff took a green leaf hopper, *Xerophloea vanduzeei* Lawson, which was found to be parasitized by two male pupae of a new parasite belonging to the genus Diozocera Pierce (1911), which is now transferred to the family Halictophagidae Pierce (1908), superfamily Halictophagoidea Pierce (1908), order Strepsiptera Kirby (1813).

There are a number of interesting points to discuss before considering the technical descriptions.

1. The host genus Xerophloea Germar (1839) contains flat-headed, green leaf hoppers, and belongs to the subfamily Gyponinae Ashmead (1890), family Cicadellidae VanDuzee (1916), of the order Homoptera (DeGeer) Westwood (1840). The genus has been monographed by P. B. Lawson in Pan-Pacific Entomologist 7(4) :159-164, and contains 13 species very closely related, separated by very superficial characters; which were until recently all considered to be one species *X. viridis* (Fabricius 1794).

2. The fact that we can find specific differences in the parasites indicates that there are distinct species of Xerophloea.

3. The genus Xerophloea, and its parasites of the genus Diozocera are very widely distributed across North America, in the West Indies and South America. This would indicate an ancient relationship, and also that there are probably many more parasites to be found.

4. We can now differentiate three distinct species of Diozocera.

5. Due to a faulty specimen the genus Diozocera was incorrectly described, and its name is now meaningless, even though under the International Rules we must continue to use it. The family Diozoceridae being based upon this faulty diagnosis is no longer needed, and the genus is transferred to the family Halictophagidae, which is composed entirely of leaf hopper parasites.

6. A careful correlation study of the structure of the male cephalotheca, or head cap of the puparium, which is the last larval head, proves some very interesting points in the morphology of the insect head, at least the head in the pupariate orders.

a. The gnathocephalon area, which includes mouth opening, mandibles, and maxillae, is definitely the terminal segment, for it is completely surrounded by the procephalon of Crampton, which includes the eyes, antennae, genae and mentum. This fact has been overlooked in my previous descriptions of males and male cephalothecae. In the genus Diozocera this fact is clearer than in the other genera and families, but is nevertheless the rule for all Strepsiptera known to me.

b. Crampton (1935) in his Principles of Insect Morphology (pp. 100-104) considers the procephalon as the terminal segment, and the gnathocephalon as between the procephalon and prothorax. The present study indicates that the gnathocephalon is composed of a dorsal sclerite with mandibles, and a ventral sclerite with maxillae, with the mouth opening between. The "procephalon" is the second segment, with the dorsal sclerite bearing labrum, and antennae; the pleural sclerite the eyes; the ventral sclerite the mentum and its appendages (labium) which are absent in the Strepsiptera. The labium is therefore a part of the venter of procephalon.

c. A study of many of Crampton's figures indicates that such an interpretation can also apply to Coleoptera and Orthoptera, but in these orders the gnathocephalon integuments are internal. Certainly in the Rhynchophora the gnathocephalon is terminal to the procephalon.

d. In my 1936 paper, The Position of the Strepsiptera in the Classification of Insects (Ent. News. 47:257-263) I showed numerous linkages between the Strepsiptera, Diptera, Coccoptera and Aleurodoptera, the pupariate orders. Another linkage can now be added. Outside of this group I do not know of any cases in which the gnathocephalon tissues are external. But in the Pyrgotidae, as illustrated by Curran (1934) in North American Diptera, p. 269, the gnathocephalon area is almost an exact picture of the same area in Diozocera, except that the mouthparts are internal. The Dipterous family Nymphomyidae, which has so many structures resembling Strepsipterous structures, leaves no doubt whatever that the gnathocephalon is terminal to the procephalon, as shown in Tokunaga's (1935) figures in Philippine Journal of Science 56(2):127-214.

e. Setting aside therefore all previous descriptions of the male cephalotheca as far as terminology is concerned, we can now describe the present species in complete accord with the general morphological terminology used by Crampton.

The clear area containing mandibles and maxillae and mouth opening is the *gnathocephalon*. The heavier chitinized area completely surrounding this is the *procephalon*.

The gnathocephalon is bounded dorsally by a straight suture between the eyes, which is medianly arched. The arched portion is truly epistomal suture. Crampton calls the suture between the parietals and gnathocephalon the subgenal suture, and divides it into pleurostomal suture dorsal to the mandibles, and hypostomal suture ventral to the mandibles. To be more exact in this case we may call the entire suture between the eyes *epistomal suture*, as it is above the mouth, with the median arch as the *frontal arch;* the continuation of this margining the eyes as *pleurostomal suture;* and the posterior margin the *hypostomal suture;* with the large process into gnathocephalon, the *mentum*.

This area includes five differentiated parts: a pair of mandibles, which apparently are functional; a pair of maxillary rudiments; and a median plate immediately above the mouth and below the frontal arch, the exposed part of the pharynx, which we will for the present call the pharyngeal plate. The edge of the mouth opening lies between this and the tip of the mentum.

The procephalon is transverse, almost straight on dorsal edge; broadly rounded at sides, convex ventrally; and the whole cephalotheca is evenly rounded dorso-ventrally. The dorso-parietal zone lies between the eyes above the epistomal suture, and includes the antennal rudiments, and a subtriangular median frontal zone indicated by fine punctures, and the remainder may be called vertex. The eye zones are lateral, nonfunctional, bordered exteriorly by the genal area which passes ventrad behind the hypostomal suture, and merges into the decapitated pyramidal mentum. An occipital suture defines a very narrow occipital zone beginning opposite the posterior tips of the gnathocephalon, and enclosing the vertex. In conformity with Crampton's nomenclature, the posterior continuation of the occipital zone, which is not marked off by a suture, but is a little lighter in color than the mentum, can be called the submentum. This area is anteriorly truncate and posteriorly arcuate.

Genus Diozocera Pierce (1911) redefined.

Dioxocera Pierce (1908). Proc. Ent. Soc. Wash. 9 (1-4) :76, 81. Error in transcription.

(1909). Bull. U. S. Nat. Mus. 66:163. Error repeated.

Diozocera Pierce (1911). Proc. U. S. Nat. Mus. 40 (1834) :504. Correction.

This change was ratified by Opinion of the International Commission of Zoological Nomenclature, in Opinion 36, July 1911.

The genus was described from a male extracted from its puparium in the host, and was not in good condition, apparently having 2-branched antennae, and 3-jointed tarsi, and was consequently made the type of the family Diozoceridae Pierce (1911). A restudy of the type by E. A. Chapin indicates that the terminal joints of the antennae are missing. We can now consider the genus as true Halictophagid, on account of the new Anacapa species.

The single species was parasitic on *Xerophloea viridis* (sens. lat.) in Grenada and St. Vincent.

In order to better describe the new Anacapa specimens, the writer has restudied the paratypes in his personal collection, and is depositing all specimens herein described, in the collection of the Los Angeles Museum.

Generic description:

Halictophagidae: parasites of the Gyponine genus *Xerophloea*, having eight jointed antennae, with five flabellated joints; and three jointed tarsi. Male head more or less enclosing laterally the prothorax and mesothorax; prescutum and scutellum separated by folds of scutum.

Diozocera insularum (Pierce 1908) Pierce (1911).
(Figures 1, 18)

Dioxocera insularum Pierce (1908).

Diozocera insularum Pierce (1911).

For comparison with the other species the cotype slides were restudied.

Cotype Female. Grand Ance (South End) Grenada, B.W.I., from ♀ *Xerophloea viridis* (sens. lat.). Cephalothorax transverse, rounded from base to apex, with margin broken by mandibles at apical angles. Breadth 0.2805 mm.; width of transverse slit 0.187 mm.; breadth at outer mandibular angles 0.187 mm.; distance between mandibles 0.085 mm.; length from spiracles to apex 0.204 mm.; from transverse slit to apex 0.1445 mm.; from mouth opening to apex 0.0425 mm. Ratio of breadth to length 1.37:1; ratio of breadth at spiracles to distance between mandibles 3.3:1. The mandibles are transverse, with a round outer angle, and sharp recurved tooth at inner angle (fig. 1); length 0.034 mm., breadth 0.0425 mm. Transverse slit rounding quadrate. Spiracles lateral.

Diozocera insularum var. vincenti new subspecies.
(Figs. 2, 7, 14, 15.)

Type Female: St. Vincent, B.W.I., from ♀ *Xerophloea viridis* Fabr. (sens. lat.), H. H. Smith coll. Cephalothorax

breadth 0.272 mm.; width of transverse slit 0.2295 mm.; breadth at outer mandibular angles 0.170 mm.; distance between mandibles 0.102 mm.; length from spiracles to apex 0.204 mm.; from transverse slit to apex 0.136 mm.; from mouth opening to apex 0.034 mm. Ratio of breadth to length 1.33:1; ratio of breadth at spiracles to distance between mandibles 2.66:1. (Fig. 2.)

This specimen differs enough from the Grenada specimen to require a subspecies name until such time as large series either demonstrate its specificity, or that both fall within the range of variation of a single species.

Cotype Male cephalotheca: In the same host were two ♂ puparia, the cephalothecae differing in size. They measure respectively as follows: Cephalotheca breadth 0.731 and 0.646 mm.; length 0.408 and 0.391 mm.; length of epistomal suture 0.408 and 0.374 mm.; greatest width of gnathocephalon 0.510 and 0.4675 mm.; ratio of width to epistomal suture 1.25:1 in both cases. Diagonal distance from epistomal-pleurostomal angle to anterior angle of mentum 0.170 and 0.136 mm.; width of mentum at apex 0.068 and 0.068 mm.; at base 0.323 and 0.272 mm. Distance between mandibles; outer points of condyles 0.306 and 0.272 mm.; inner points 0.119 and 0.119 mm.; width of mandibles 0.051 and 0.0425 mm. Distance between maxillae 0.170 and 0.170 mm. Distance between antennae, outer margins 0.357 and 0.323 mm.; between inner margins 0.238 and 0.2295 mm.; ratio of these measurements 1.4:1 and 1.5:1. Distance from most remote point on hypostomal margin to lateral angle of frontal arch 0.255 and 0.255 mm. Distance from epistomal-pleurostomal angle to mentum through center of maxilla 0.1445 and 0.153 mm. Ratio of these last two measures of the gnathocephalon 1.66:1 and 1.76:1.

Antennae diagonal, elliptical. Mandibles darker than surrounding area, with round prominence and acute inner tooth (fig. 7). Maxillae oblique. Mentum strongly constricted just before apex to width of pharyngeal tube. Pharyngeal plate transverse elliptical, clear.

The outline of the mentum is quite different in the three species as may be seen from the photomicrographs (figs. 14, 15).

Diozocera argentinae, new species. (Figs. 3, 8, 10 11).

Described from one male cephalotheca, and an imperfect female from a leaf hopper, which was determined, perhaps incorrectly as *Xerophloea viridis* Fabr., from Carcaraña, Argentina, collected by Lawrence Bruner.

Male cephalotheca: breadth 0.807 mm.; length 0.467 mm. Length of epistomal suture, or anterior width of gnathocephalon 0.408 mm.; greatest width of gnathocephalon 0.561; ratio of the second to the first 1.37:1. Diagonal distance from epistomal-

pleurostomal angle to anterior angle of mentum 0.170 mm.; width of mentum at apex 0.102 mm., and at base 0.425 mm. Distance between mandibles, outer points of condyles 0.306 mm.; inner points 0.119 mm.; width of mandible 0.051 mm. Distance between maxillae 0.1785 mm. Distance between antennae, outer margin 0.340 mm., inner margin 0.238 mm.; ratio 1.42:1. Distance from most remote point on hypostomal margin to lateral angle of frontal arch 0.289 mm.; distance from epistomal-pleurostomal angle to mentum through center of maxilla 0.187 mm.; ratio of these two dimensions of gnathocephalon 1.54:1.

The front is faintly suggested by tiny punctures. The antennae are obliquely elliptical with a cluster of tiny punctures in an elliptical zone in the outer posterior sector. Mandibles yellow, with a round prominence, and sharp inner recurved tooth (fig. 8.) Maxillae oblique, elliptical with an inner ring, indicating second segment. Pharyngeal plate chitinized, wider than long in the proportion 7:5; margin of mouth opening minutely crenulate. Mentum convexly rounded, short of mouth opening, exposing the apex of the more constricted pharyngeal tube. (Figs. 8, 10, 11.)

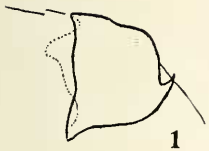
Female: The female is in two fragments, but otherwise perfectly describable. Cephalothorax transverse, obtusely angled at apical angles and also at apex. Breadth 0.374 mm.; width of transverse slit 0.154 mm.; breadth at out apical angles 0.255 mm.; distance between mandibles 0.102 mm. Length from spiracles to apex 0.2295 mm.; from transverse slit to apex 0.1785 mm.; distance from base of mouth opening to apex 0.0595 mm. Ratio of breadth at spiracles to distance between mandibles 3.66:1. Ratio of breadth to length 1.6:1. The mandibles are on apical margin but not at apical angles, transverse, blunt, sharply concave in middle with acute tooth (fig. 3); length 0.034 mm., breadth 0.0399 mm. Mouth opening broadly oval. Transverse slit broadly arcuate, slightly angulate posteriad at middle. Spiracles ventral. Immediately behind the transverse slit the body is greatly enlarged to fit into the host.

This species differs from D. insularum very distinctly by the angulate form of the cephalothorax; the position of the mandibles in the female; the mandibles, and the shape of the mentum and gnathocephalon in the male cephalotheca.

Diozocera comstocki, new species. (Figs. 5, 6, 9, 12, 13)

Named in honor of my friend and associate Dr. John Adams Comstock, Director of Science of the Los Angeles Museum, under whose direction the Channel Islands Survey is being conducted.

Described from two male pupae in the first and last segments of a ♀ *Xerophloea vanduzeei* Lawson taken on West Anacapa



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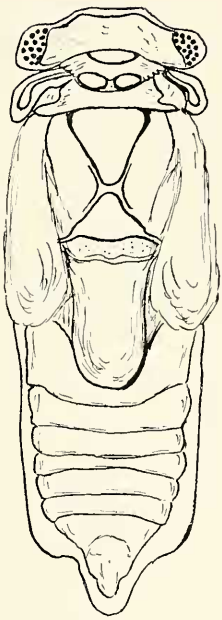

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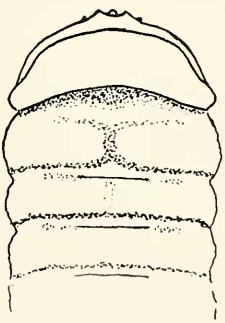

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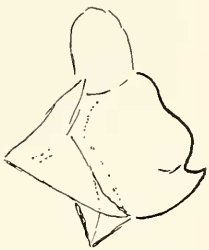

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PLATE 1

For explanation of figures, see page 10.

Island, August 21, 1940, under *Atriplex semibaccata,* by George P. Kanakoff.

Male: One pupa is so far advanced that the male dorsal characters are clearly seen through the pupal skin. The other pupa is too young. Head broad, transverse. Antennae with five flabellations, about equal in length. Pronotum a transverse disk completely enclosed by head and mesothorax. Mesonotum appears to be composed of a transverse prescutum, a divided scutum, and transverse scutellum. The metathorax consists of a keystone-like prescutum, which is narrowly separated from the scutellum by a bridge uniting the large lateral scutal sclerites. The scutellum is basally widest, with a narrow projection to the posterior wing attachment; in front of this the sides are parallel for a short distance and then rapidly oblique to the rounded apex. The postlumbium is about half the length of scutellum, of thinner texture, and closely minutely granulate. The postscutellum is with the postlumbium as long as the anterior portion of the methathorax.

On the sternum each segment is divided by a median line.

Male cephalotheca. Breadth 0.7735 mm. and 0.7565 mm.; length 0.408 mm. and 0.442 mm. Length of epistomal suture, or anterior width of gnathocephalon 0.3995 mm. and 0.391 mm.; greatest width of gnathocephalon 0.527 mm. and 0.5355 mm.; ratio of the second to the first measurement 1.31:1 and 1.36:1. Diagonal distance from epistomal-pleurostomal angle to anterior angle of mentum 0.170 mm. and 0.1615 mm.; width of mentum at apex 0.102 mm. and 0.102 mm.; and at base 0.323 mm. and 0.340 mm. Distance between mandibles, outer points of condyles 0.323 mm. and 0.3145 mm.; inner points of condylyes 0.102 mm. and 0.102 mm.; width of mandibles 0.051 mm. and 0.051 mm. Distance between maxillae 0.187 mm. and 0.187 mm. Distance between antennae, outer margins 0.374 mm. and 0.357 mm., inner margins 0.255 mm. and 0.221 mm.; ratio 1.45:1 and 1.61:1. Distance from most remote point on hypostomal margin to lateral angle of frontal arch 0.2805 mm. and 0.289 mm.; distance from epistomal-pleurostomal angle to mentum through center of maxilla 0.1615 mm. and 0.153 mm.; ratio of these measurements of gnathocephalon 1.73:1 and 1.88:1.

Antennae diagonal, suboval, truncate at inner end; central zone with cluster of pores. Mandibles orange color with dark brown condyles, armed with acute curved tooth on inner angle (fig. 9). Maxillary area slightly darker, oblique, with concentric rings. Mentum divided into two zones, a broad basal zone with sides subparallel for one-third the length, thence strongly diagonal; anterior zone sharply separated from basal by concave dark zone, margins less distinct; a quadrate area darker, reaching mouth opening. Pharyngeal area hemispherical and of different color from all other areas, gray brown. The frontal area is marked by two roughened zones (figs. 12, 13).

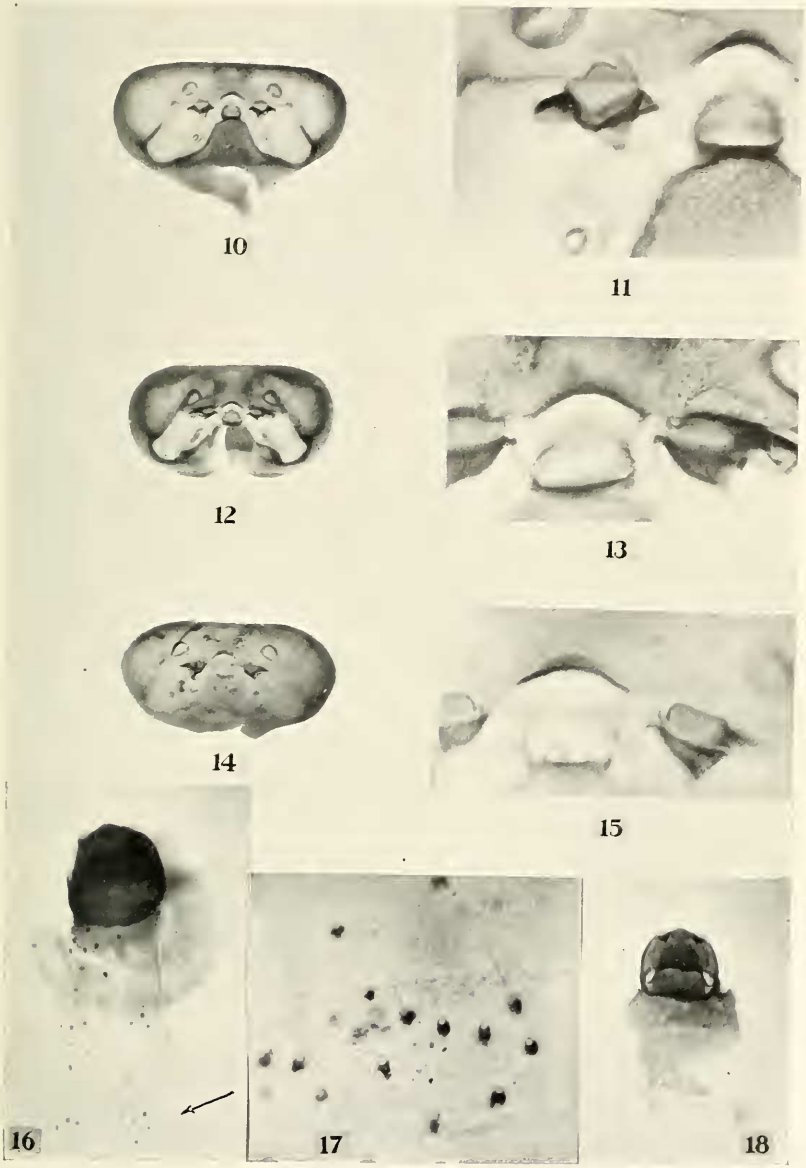

PLATE 2

For explanation of figures, see page 10.

Diozocera comstocki elsegundinis, new subspecies
(Figs. 4, 16, 17).

Until such time that we have both sexes from the type localities we cannot be positive that the female described below belongs with the males described from Anacapa Island, hence for safety it is necessary to give this subspecific name.

Described from one female extracted from the last segment of a female *Xerophloea vanduzeei* on *Franseria bipinnatifida,* collected by W. Dwight Pierce, on the El Segundo sand dunes, Los Angeles Co., Cal., July 13, 1938.

Female: Cephalothorax breadth 0.340 mm.; width of transverse slit 0.272 mm.; breadth at outer mandibular angles 0.221 mm.; distance between mandibles 0.119 mm. Length from spiracles to apex 0.221 mm.; from transverse slit to apex 0.187 mm.; from mouth opening to apex 0.051 mm. Ratio of breadth to length 1.54:1; ratio of breadth at spiracles to distance between mandibles 2.85:1.

The specimen was broken at left anterior corner (fig. 16). The mandibles have a rounded outer angle and sharp recurved tooth at inner angle (fig. 4). The abdominal skin is minutely, densely covered with conical transparent papillae, interspersed with many dark cylindrical setigerous tubercles; these measuring 0.015 mm. in length by 0.012 mm. breadth, and the setae measure 0.06 mm. in length (figs. 16, 17).

ILLUSTRATIONS

Plate 1:

Fig. 1. Mandible of ♀ *Diozocera insularum* from Grenada.
2. Mandible of ♀ *D. insularum vincenti* from St. Vincent.
3. Mandible of ♀ *D. argentinae* from Argentina.
4. Mandible of ♀ *D. comstocki elsegundinis* from El Segundo, Cal.
5. Dorsum of ♂ pupa of *D. comstocki* from Anacapa Isl., Cal.
6. Dorsum of ♂ puparium of *D. comstocki.*
7. Mandible of ♂ cephalotheca of *D. insularum vincenti* from St. Vincent.
8. Mandible of ♂ cephalotheca of *D. argentinae* from Argentina.
9. Mandible of ♂ cephalotheca of *D. comstocki.*

Plate 2:

Fig. 10. Cephalotheca of ♂ *D. argentinae.*
11. Enlargement of face of ♂ cephalotheca of *D. argentinae.*
12. Cephalotheca of ♂ *D. comstocki.*
13. Enlargement of face of ♂ cephalotheca of *D. comstocki.*
14. Cephalotheca of ♂ *D. insularum vincenti.*
15. Enlargement of face of ♂ cephalotheca of *D. i. vincenti.*
16. Anterior portion of ♀ *D. comstocki elsegundinis.*
17. Enlargement of portion of fig. 16 marked by arrow to show tubercles.
18. Anterior portion of ♀ *D. insularum.*